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## **A PROTECTIVE APPLIANCE**

THIS INVENTION concerns an appliance for protection against impact and strain injury and is particularly intended to prevent such injuries to sports people.

In certain sports, such as football for example, players are particularly vulnerable to injury of the lower leg including bruised lower shins, swelling of the softer muscle tissue on the inner shin, bruised ankles, abrasions to the calves and rear of the leg and swelling or bruising to the Achilles tendon. Many of these injuries occur as a result of impact but also muscle and tendon strain.

Conventional injury prevention means in general include such as elasticated sleeves adapted to be applied over joints or sensitive areas of the body, and devices known as shin pads i.e. one-piece rigid shields which are worn, for example, beneath a football sock. Existing shin-pad designs, whilst effective to a degree, offer a limited level of protection against many of the aforesaid types of injury. One weakness of the standard shin pad is that as a result of a head-on or side-on impact, the pad tends to slip around the lower leg beneath the sock and thus does not provide sufficient impact resistance.

The present invention is concerned with providing a protective appliance which conforms closely to the shape of a body part and which affords adequate impact resistance.

whilst maintaining its position in use. A further object of the present device is to ensure that the force of an impact is distributed throughout the appliance thus minimising localised bruising.

Commensurate with affording adequate protection, the wearer must retain complete freedom of movement so as not to impair physical performance and also to ensure that muscle injury due to unnatural movement or restraint, does not occur.

Patent specification GB 2328859 describes a protective appliance including a flexible web or sleeve adapted to be worn about a part of the body and to conform closely to the shape thereof, and a plurality of interconnected plates of an impact-resistant material attached to or adapted to be attached to the web or sleeve such as to permit limited relative movement between the plates. The plates are described as being attached directly to the web or sleeve or threaded onto a central elasticated strip where the strip is attached to the web or sleeve. The plates are individually and independently movable relative to each other and to the elasticated strip. In another embodiment as described in GB 2328859 the plates are interconnected by being individually and directly stitched onto the web or sleeve without being connected together upon a common strip.

An object of the present invention is to provide an improved appliance of this general kind and which permits greater flexibility of use and may be interchangeable with other such devices or movable from garment to garment.

According to the present invention, an appliance for protection against impact and strain injury includes a plurality of interconnected plates of an impact resistant material attached to or adapted to be attached to an article to be worn about a part of the body such as to permit limited relative movement between the plates; characterised in that the plates are aligned along a common backing member; and in that means are provided for removably mounting the appliance on an article to be worn.

The backing member may be one or more ligaments extending centrally or in spaced disposition along the appliance.

The interconnected plates may be attached to the backing member in mutually overlapping relationship.

At least two of the interconnected plates may be mounted in fixed relative disposition along the backing member.

The backing member may be elasticated.

The backing member may form, or include a fastener thus to be removably attachable to a part of a garment.

The backing member may form, or include; one part of a strip of hook and loop fastener thus to be removably attachable to a part of a garment.

The appliance may be contained within a sleeve removably or permanently attached to a garment.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 illustrates a known appliance for protection against impact and strain injury, such as is described in GB 2328859;

Fig. 2 illustrates an appliance made in accordance with one embodiment of the invention;

Fig. 3 illustrates a means of attachment of the appliance to a garment;

Fig. 4 illustrates another means of attachment;

Fig. 5 shows an example of the appliance in use on a glove;

Fig. 6 shows an example of the appliance in use as a lower leg protector;

Fig. 7 shows a further example of the appliance in use as a lower leg protector;

Fig. 8 is a front view showing an example of the appliance in use on a unitard;

Fig. 9 is a rear view of the example shown in Fig. 8;

Fig. 10 shows an example of the appliance in use as a shoulder protector;

Fig. 11 shows an example of the appliance in use as a elbow protector;

Fig. 12 shows an example of the appliance in use as a hip protector;

Fig. 13 illustrates how a part of the appliance is removed from another part thereof;

Fig. 14 is a rear view of a lower leg protector incorporating several appliances made in accordance with the invention; with one appliance shown removed;

Fig. 15 is a rear view of an appliance made in accordance with a further embodiment of the invention; and

Fig. 16 is a view similar to Fig. 15 of an appliance made in accordance with a still further embodiment; and

Fig. 17 is a view similar to Fig. 15 made in accordance with a still further embodiment.

The known appliance shown in Fig. 1, for wearing upon the lower leg comprises an inner elasticated sock 10 made from stretch neoprene rather like an elasticated joint protector but which covers the entire lower leg from just below the knee down to around the ankle. The sock 10 is shaped to the natural contour of the leg, hugging the structure of the muscles and the tendons and providing a non-slip base around which the rest of the appliance is created. The material of the sock 10 affords an excellent grip which helps it stay in position whilst at the same time enabling completely free movement of the lower leg, and a stirrup 11 may be provided to pass under the foot.

An outer protective layer is provided in the form of "stretch armour" and consists of a number of panels 12 each comprising a vertical column of overlapping plates 13 of an impact-resistant material such as a high density polyethylene, connected together on, and movable with respect to, an inner central strip of elastic. The degree of rigidity and yet potential overall flexibility is selected to provide the desired properties of impact resistance and distribution while retaining complete freedom of movement for the wearer.

Each such panel 12 of stretch armour and elastic strip is stitched at its opposed ends, as shown at 14, to the inner sock 10.

The plates 13 of each panel, although overlapping and to some extent nesting together, are of progressively varying shape and dimensions throughout the length of the panel thus to conform to the shape of the limb. Thus, for example, the front panel 12 has plates which are wider at the top and gradually reduce in width down towards the ankle.

The panels 12 may overlap where appropriate to provide a complete shield around the lower leg leaving a space only where necessary to ensure complete freedom of movement.

Owing to the overlapping configuration of the plates 13, the force of any impact is distributed throughout the associated panel 12 and thus dispersed over a large surface area with the effect of minimising localised bruising.

The entire appliance, because of its close conformity with the shape of the leg may be worn conveniently beneath, for example, a football sock and thus can be concealed thereby.

A similar appliance may be adapted for use on any part of the body but particularly those parts most prone to impact injury.

Referring now to Fig. 2, in accordance with a first embodiment of the present invention, the panels 12 are constructed such as to be removably attachable to the sock 10 or to any article to be worn about a part of the body to be protected. Thus, the plates 15 are arranged in overlapping relationship and each attached, for example by stitching, to an elastic backing member or ligament 16. In this embodiment the stitching can be seen at 17 whereby relative movement of the plates 15 is afforded only by the resilient nature of the ligament 16.

Accordingly, the appliance is constructed independently of the article to which it is to be attached and may thus be applied to the article at any selected location. Tapes 18



of hook and loop fastener such as that sold under the registered trade mark VELCRO are permanently attached to the ligament 16 in the two end regions thereof whereby the appliance can be readily attached to, and detached from, the garment.

Figure 2 illustrates, for example, a shoulder protection appliance such that the plates 15 follow the line of the shoulder and the upper arm to protect that region of the body from impact injury.

Alternatively, an appliance such as shown in Fig. 2 can be located directly over the leg in the area of the shin thus to act as a shin protector, or to any other area of the body to be protected.

The elasticated nature of the ligament 16 maintains the plates 15 in the correct relative orientation but allows for relative movement between them as the appliance bends, due to the flexible and resilient nature of the ligaments..

In place of the VELCRO fastener tapes 18, the ends of the ligament may be removably attached to a garment, and replaceable thereon, by means of adhesive tapes, press studs or the like. By making the appliance detachable it can be replaced by one having different properties of rigidity or flexibility, or when worn or damaged.

Referring now to Fig. 3, there is illustrated a part of a garment with which the appliance is to be used, for example, an elasticated knee support sleeve 19. A strip 20 of

VELCRO may be permanently attached to the sleeve 19 and the ligament 16 may have spaced apart VELCRO tabs 21 as shown.

Referring now to Fig. 4, in this example the appliance is wholly enclosed within a mesh pouch 22 closed by VELCRO strips 23 attachable to VELCRO strips 24 permanently affixed to the sleeve 19. In this case, there is no need for the user to wear additional clothing outside the pouch 22 unlike the embodiment in Figs. 2 and 3 where it may be considered necessary or desirable to wear another sock outside the appliance.

Referring now to Fig. 5, there is shown an example where several strips of the appliance are attached to the back of a glove 25 thus to protect the wearer's hand against crush injury.

Referring now to Fig. 6, in this example an elastic sock 26 has attached thereto several lengths of the appliance for example for a shin guard 27, ankle guards 28 and a further guard 29 at the rear to protect the Achilles tendon region.

Referring now to Fig. 7, there is shown an alternative arrangement in which a number of the appliances are attached to the sock 26 by insertion into mesh pockets 27 similar to that described in relation to Fig. 4, such that the appliances may be introduced selectively according to user requirements.

Fig. 8 illustrates a front view of a unitard being a flexible body garment 28, and in this case further mesh pockets 29 are provided to receive, selectively, one or more appliances in the shoulder, breast, ribs and hips regions.

Fig. 9, being the rear view, illustrates appliances 30 also in the elbow regions.

Referring now to Fig. 10, it can be seen that the appliance may be formed such that each plate 15 may consist of an outer shell 31 and a core 32 of a more highly impact resistant material thus to improve impact absorption and distribution through the structure of the appliance. This construction may apply to any of the appliances described and illustrated in this application and is an alternative to a construction in which some or all of the plates are made from a single material.

Referring now to Fig. 11 the appliances 30 of Fig. 9 are illustrated once again as being removable from a mesh pocket 34.

Fig. 12 similarly illustrates a hip protection appliance 35 and its containment within a mesh pouch 36.

Referring now to Fig. 13, it will be seen that the appliance 37 is readily removable from its mesh pouch 38 using the strips 23 and 24 of VELCRO fastener as referred to in relation to Fig. 4.

Referring now to Fig. 14, there is shown a complete lower leg protector comprising a flexible sock 45 upon which are mounted several appliances 46 two in the calf region, one in the frontal shin region and one in the upper heel region.

The appliances 46 are removably attached to the sock 45 as will be described, and a further pair of appliances 47 may be non-removably mounted on both sides of the ankle region.

Referring now to Fig. 15, in a further embodiment the removable appliance consists of an array of overlapping rigid plates 48 as in previously described embodiments. In this case the plates are individually threaded as at 49 onto a single flexible tape or ligament 50. The two end plates are preferably stitched or otherwise permanently attached to the ligament 50 as shown at 51. A strip 52 of VELCRO is applied over the ligament 50 and may have a self-adhesive backing surface 53 thus to become bonded to the ligament 50 and each of the plates 48. If required, the strip 52 may also be stitched as at 54 to the outermost end plates 48. Thus, the appliance is self-contained and attachable to the sock 45 bearing the corresponding strip 55 of VELCRO, preferably stitched to the sock 45, or to any other sleeve or garment bearing such a strip as illustrated at 55 in Fig. 14.

Thus, the appliances 46 are removable from the sock 45 for washing and for replacement if they become damaged. Removability of the appliances 46 enable the wearer to select the required impact resistant characteristics. For this purpose, appliances having a variety of levels of rigidity may be made available.

Referring now to Fig. 16, in an alternative arrangement the ligament 50 is replaced directly by a strip 56 of VELCRO which may be attached to any or all of the plates 48 by stitching and/or bonding. In some cases the surface characteristics of the VELCRO strip are sufficient to retain the plates 48 in fixed relative disposition along the strip but for additional security the two end plates may be stitched to the strip.

Optionally, press studs or further VELCRO fixings 57 may be located in the side regions of the end plate 48 to become engaged with the sock or garment thus to provide additional security preventing the side edges of the plates from lifting in use. Such additional fixings may be provided on some or all of the plates 48.

Referring now to Fig. 17, it will be seen that the plates 15 may be threadedly mounted on (or stitched to) a pair of ligaments 60 (which may be elasticated or strips of velcro) arranged in spaced parallel disposition along the appliance, thus to assist in the prevention of the individual plates from twisting or rotating, but still affording adequate relative movement between them. Two ligaments also serve to prevent the side regions of the plates from lifting and maintain the assembly of plates in correct alignment and degree of overlap. Alternatively, a single broad ligament can be provided.

The appliances may be made available in a number of different thicknesses or grades of rigidity and strength. For example, a user having a recent injury may apply a thicker or heavier grade of appliance initially and then reduce its thickness and weight during the recovery period.

Thus, it will be seen that the ability to remove the appliance from a particular garment and to replace it when required enables different protective properties to be employed and the appliance is removable from the garment for washing both the garment and the appliance.

While the appliance is ideal for use by people engaged in sports activities it may be used also by law enforcement personnel or for medical and surgical applications where, for example, a limb is required to be immobilised or merely protected from touch or impact.

Having a central common ligament (or a pair of spaced parallel ligaments) which is preferably, though not essentially, elasticated, the appliance is self contained, simple to manufacture and can be made available in different widths and lengths. Furthermore, the length of a particular appliance may be reduced by removal of several of the plates 13, for example, by cutting the ligament to the required length.

The ability of the appliance to distribute or dissipate impact energy throughout the plate assembly, affords the wearer a degree of control over the effect of the impact. For example, in a sports environment, the speed and direction of rebound of a ball impacting upon the appliance may be better controlled by a player as a result of the force dissipation.